

## OBJECT DETECTION BY SIGNAL FIELD MAPPING

### BACKGROUND OF THE INVENTION

5 The present invention relates to object detection, and more particularly to an apparatus for detecting an object in the path of a vehicle power window.

Power window mechanisms are commonly known. Recently, one-touch up power windows have been included in vehicles which allow the window to be closed by a single press of the power window operating button. Additionally, such mechanisms are known for vehicle sunroofs and the like. The proliferation of such power window mechanisms  
10 has increased the possibility that an object could be captured in the closing window.

Accordingly, it is desirable to provide an object detection system to prevent such possibility of capture. It is further desirable to provide a robust, reliable, lightweight and inexpensive system for vehicle use.

### SUMMARY OF THE INVENTION

15 The object detection system of the present invention generally includes an emitter, a receiver, and a controller attachable to a window assembly that typically includes a moveable closure member and a frame. Although a window is shown and described, the present invention is similarly applicable to a vehicle sunroof/moonroof or other closure  
20 members.

In operation the emitter transmits a signal through a defined field adjacent a closure path of a moveable closure member. The controller preferably constructs a "normal" map signature of the received signal which includes the obstructions normally within the defined field. The "normal" map signature is used by the controller as a  
25 reference and indicates that no unknown objects are within the defined field.

However, when an unknown object enters within the defined field, a variation from the "normal" map signature is constructed by the controller. The controller compares the varied map signature to the "normal" map signature and identifies the differences. Any

10           The various features and advantages of this invention will become apparent to those skilled in the art from the following detailed description of the currently preferred embodiment. The drawings that accompany the detailed description can be briefly described as follows:

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according to the present invention;

invention; and

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As shown in Figure 2, the system 10 generally includes an emitter 18, a receiver 20, and a controller 22 attachable to the window assembly 12. As will be more fully described below, the emitter 18 transmits a signal (shown schematically at 24) through a defined field 26 adjacent the closure path 15 of moveable closure member 14. The controller 22 constructs a map of the signal 24 received by the receiver 20 such that insertion of an object (shown schematically at 33) within the defined field produces a variation in the map. The controller 22 can then halt or reverse the movement of the moveable closure member 14 to prevent trapping object 33 between the closing moveable glass member 14 and the frame 16.

The emitter 18 is preferably positioned adjacent the moveable glass member 14 in the frame 16. The receiver 20 is mounted adjacent the moveable glass member 14 in the frame 16 to receive the signal 24 reflection. It is further preferred that a second emitter 18' and receiver 20' are mounted adjacent the moveable closure member 14. The second emitter 18' transmits a second signal (shown schematically at 24') through a second defined field 26' adjacent the closure path 15 of moveable closure member 14.

When an unknown object 33 is determined to be within the defined field 26, the controller 22 halts or reverses the movement of the moveable glass member 14 to prevent trapping the object between the closing moveable closure member 14 and the frame 16. To achieve this control, controller 22 communicates with an actuator 34 for the moveable closure member 14. To conserve power, the emitter 18 can be maintained in a dormant state and operated only when the actuator 34 is operating and the moveable closure member 14 is being closed.

In operation, the emitter 18 transmits the signal 24 within the defined field 26. The signal 24 is preferably an electromagnetic or ultrasonic signal and emitter 18 may transmit the signal 24 continuously or in a pulse to minimize power usage.

The transmitted signal 24 will reflect from obstructions that are always within the defined field 26 such as portions of the frame 16. The receiver 20 will therefore receive a relatively constant reflection which is identified by the controller 22. Whereas the receiver 20 receives a relatively constant signal 24 reflection, the controller 22 constructs

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"normal" map signature 30 is not adjusted. Any object 33 that is identified in both defined fields 26, 26' both inside and outside the window, is in the closure path 15 and is an undesirable obstruction. Thus, as illustrated in the top view of Figure 4, if the object 33 is in both defined fields 26, 26', the controller 22 can halt or reverse the movement of the moveable glass member 14.

The foregoing description is exemplary rather than defined by the limitations within. Many modifications and variations of the present invention are possible in light of the above teachings. The preferred embodiments of this invention have been disclosed, however, one of ordinary skill in the art would recognize that certain modifications would come within the scope of this invention. It is, therefore, to be understood that within the scope of the appended claims, the invention may be practiced otherwise than as specifically described. For that reason the following claims should be studied to determine the true scope and content of this invention.